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is the process of senility in the animal can not be unrepresented in the plant world.

HARRIS M. BENEDICT
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THE METRIC SYSTEM

REFERRING to the article, "Progress in Metric Standardization," by Professor Bingham in your impression for March 3, it seems impossible to make the metric party understand that while, in some applications, the adoption of the metric system is easy, in others it is supremely difficult. It has been shown repeatedly that the easiest of all units to change are those of capacity and that the easiest of all places in which to adopt the system is the scientific laboratory, and the metric argument is that, these changes being easy, therefore all others are easy, when the fact is that others are so difficult that they have not been brought about in any country in the world, the net result being a dual or mixed system to which the arguments advanced for the metric system have no application.

Your readers should obtain the recent Report of the National Industrial Conference Board on this subject, which is the result of an investigation that consumed a year and is the most exhaustive that has ever been made and which confirms *all* of our contentions. Moreover, the Report is signed, without reservation, by two members of the Council of the American Metric Association who, the facts being established, signed it because they could not do otherwise.

Within a year a committee of the Conjoint Board of Scientific Societies of Great Britain, representing forty-nine scientific societies, representing, in turn, every conceivable phase of scientific activity, have made a unanimous report recommending that the metric system be *not* adopted in Great Britain.

Moreover, these are but examples. During the past century seven investigations worthy of that name have been made in this country and Great Britain, the result of every one being adverse to the claims made for the system. The plain fact is that the metric party always lose when both sides are heard, the most recent example being at the late convention of the

Chamber of Commerce of the United States of America.

The weakness of the metric party today lies in their refusal to read the anti metric case. Because of this, their representatives went before the Senate Committee on Manufactures during the past winter at Washington and repeated claims that were disproven twenty years ago. The case was thus made extremely easy for the opposition, as we had only to point out the facts in order to show not only that the metric party had no case, but also to discredit their witnesses as incompetent.

There is no better illustration of this failure to acquaint themselves with the facts than Professor Bingham's naive assumption that the opposition is composed of "a few gage manufacturers."

It is interesting to note that, after we have been assured for many years that the system is "universal" in Chemistry, you are now inaugurating a campaign to bring about its use by chemical manufacturers.

FREDERICK A. HALSEY,
COMMISSIONER OF THE AMERICAN INSTITUTE
OF WEIGHTS AND MEASURES

THIS letter is suggested by Mr. Eugene C. Bingham's article on "Progress of Metric Standardization" in the March 3 number.

I am an ardent advocate of the metric system, and feel that one of the greatest difficulties in bringing it into general use has been our prolonged period of consideration, during which many of us have been really working with two systems, and have borne all the burdens which that condition imposes.

The Drug Trade and Pharmacy generally has probably gone as far in the change as any other commercial group, but if the system were made compulsory there would be a large number of changes, some requiring an act of Congress. For example, that requiring that certain medicines bear the content of certain drugs—Opium, in grains per fluid ounce.

For the transition period certain comparative tables will be necessary—a comparative table showing prices in dollars and cents per Avoirdupois pound or ounce equals dollars and cents per kilo or grams.

The Bureau of Standards recently advised me that they did not know of any such publication, yet it seems that this would be one of the first requirements for a commercial change, and if it were now provided, might clear the way for the next step. The willingness of certain chemical manufacturers and dealers to furnish goods in metric quantities, does not amount to very much—it is easily done, and has been done automatically since the demand appeared, but a few more practical suggestions with the necessary tools (such as conversion tables as above) would greatly smooth the way in the eyes of the average business man, who is probably accounted the greatest opponent of the change.

HENRY PAUL BUSCH

CONCERNING THE ARTICLE "A NEW GRAPHIC ANALYTIC METHOD"

IN an article entitled, "A New Graphic Analytic Method," in SCIENCE of October 7, 1921, Mr. R. von Huhn states a method of deriving the graph of a special case of a function of a function. Stated in more usual mathematical terms:

Given the curves that represent

$$\begin{aligned}y &= kx + m, \\z &= hy + n,\end{aligned}$$

the curve that represents the resulting equation

$$z = lx + q$$

is drawn.

Essentially the same method, in a far more general form, and in a more usual mathematical formulation has been given by several mathematicians. See the articles by E. H. Moore, "Cross-section paper as a mathematical instrument," in *The School Review*, May, 1906, and by A. Kempner, "Some hints on plotting graphs in analytic geometry," in *The American Mathematical Monthly*, Vol. XXIV, pp. 17-21, and, in particular, the more specific article by W. H. Roever, "Graphical constructions for a function of a function and for a function given by a pair of parametric equations," in "*The American Mathematical Monthly*, Vol. XXIII, pp. 330-333. E. R. Hedrick has suggested the modification of transferring points from one of the two like-named axes to the other by means of a 45° triangle and he has also empha-

sized the geometric interpretation of the operation as that of finding the projection on the plane xy of the intersection of the two cylindrical surfaces

$$F(x, y) = 0, \quad \Phi(y, z) = 0$$

This perfectly general problem was well-known to mathematicians and hence the special case treated in the article mentioned above can not be regarded as novel.

W. H. ROEVER
E. R. HEDRICK

WASHINGTON UNIVERSITY

SPECIAL ARTICLES

THE PROPERTIES OF ELEMENTS AND SALTS AS RELATED TO THE DIMENSIONS OF ATOMS AND IONS¹

(*An Application of Geometry to the Study of Inorganic Chemistry*)

RECENTLY great interest has been aroused in connection with the determination of the dimensions of atoms and ions by various methods; particularly that of X-ray crystal analysis,—by Bragg, Landé, Hull, Davey, and others. Very recently Fajans and Grimm, and later Biltz and also Henglein have pointed out that there is a very simple linear relation between the volume of certain series of salts and the atomic volumes of their constituents. Six years ago Professor W. D. Harkins and the writer began work upon what are known as complex chemical compounds, such as ammines and hydrates, in an attempt to show that a large number of the properties of these compounds, as well as those of simple salts, are very simply related to the sizes of the atoms, atomic groups, and ions, from which the salts are built. This point of view has now been developed in considerable detail by the writer. The simplicity of the relation is apparent when it is realized that for a number of groups in the periodic system of the most common elements, as many as 35 properties of their simple compounds have been found to be related in a linear way to the atomic and ionic volumes of

¹ From an address presented at the University of Chicago in December, 1921, and to the Harvard-Technology Chemical Club in January, 1922.